



# Max Jet Pump Technology & Applications

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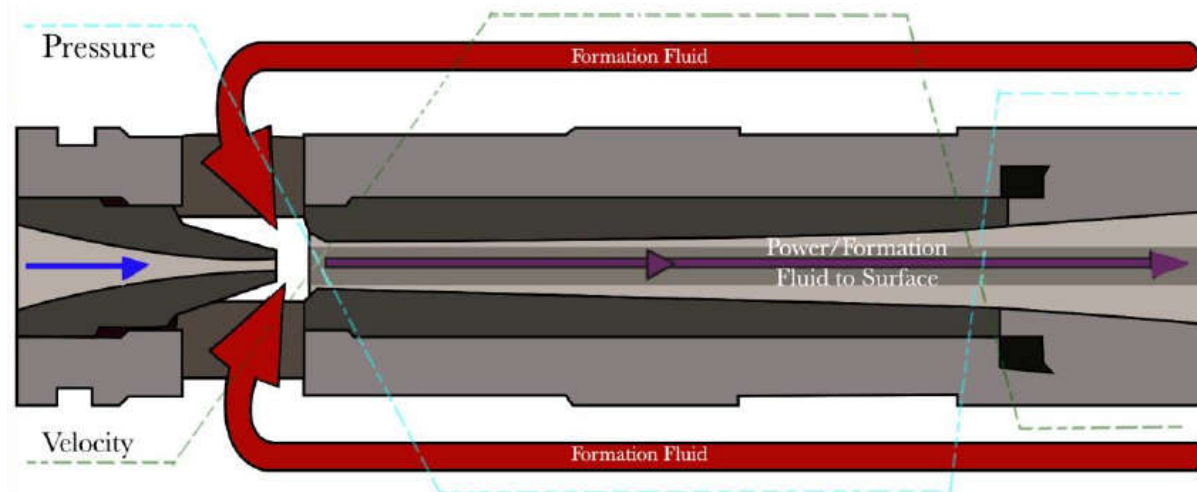


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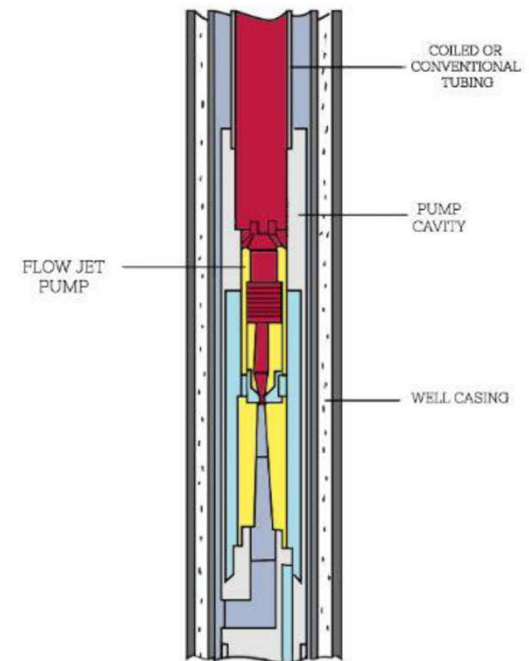
## Jet Pump Technology Overview

- Power fluid at high pressure (low velocity) is converted to a low pressure (high velocity) jet by the nozzle
- The pressure at the entrance of the throat becomes lower as the power fluid rate is increased
- When this pressure becomes lower than the pressure in the suction passageway, fluid is drawn in from the well bore hence creating underbalanced situation below the pump



# Jet Pump Technology Applications

- Backup/Replacement for ESP, GL (Permanent)
- Well Kick-off, Liquid unloading (Non-Permanent)
- Drill Stem Test (Non-Permanent)
- Production Multi rate Testing (Permanent)
- Acid Recovery, Well Cleaning (Non-Permanent)
- Frac Fluid Recovery (Non-Permanent)
- Damaged Casing and/or Packer (Permanent)
- Economic Production Lift (Permanent)
- High level H<sub>2</sub>S wells (Permanent)



## Max Jet Drill Clean System

Solves the problem of cleaning the wellbore from sand, proppant, mud sediments by drilling out hard top plug, flushing or pumping out contaminants to the wellhead in one run operation using a packer that does not require permanent setting in hole (sliding cup packer tool)

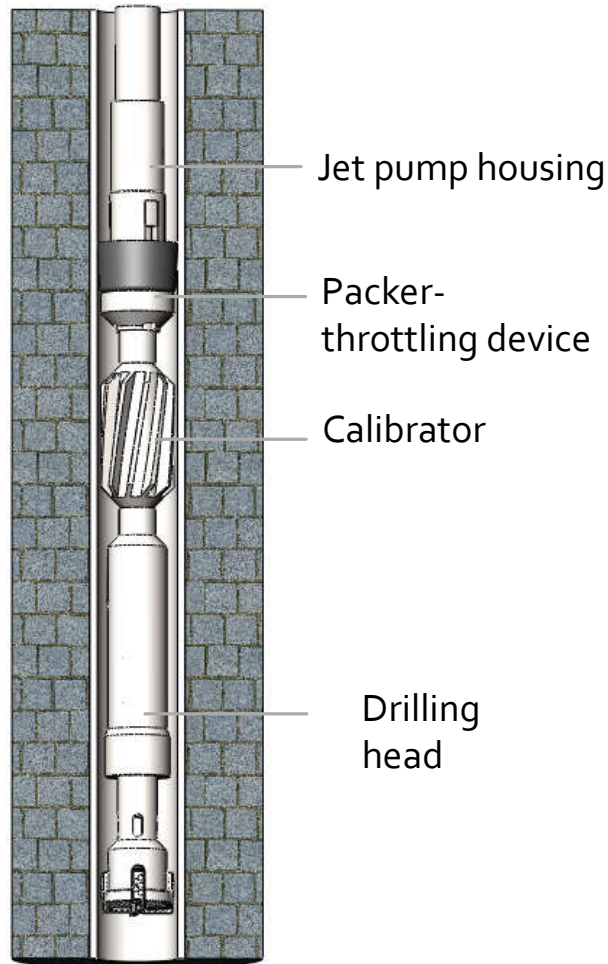
Applicable in following cases:

- Run on standard workover rig with standard tubing (eliminates the need for expensive CCT unit)
- This system uses a single-phase fluid that enables the cleanout to be performed with simplified logistics and reduced costs when compared with circulating nitrified fluids.
- Liquid pumped down the CCT's inner tubing string and through the jet pump nozzle creates a localized pressure drop that essentially vacuums wellbore fluids and entrained solids.
- Remove sand and solids in a single run

## Max Jet Drill Clean System - Cntd

- Eliminate the need for nitrogen for circulation, thus reducing logistical issues and reducing costs
- Ultralow-pressure reservoirs
- Well cleanup and unloading
- Heavy-oil and sand-producing wells
- Directional, horizontal, including small-diameter wells:
  - with low reservoir pressure;
  - with high losses;
  - low production rates.

## Max Jet Drill Clean System - BHA



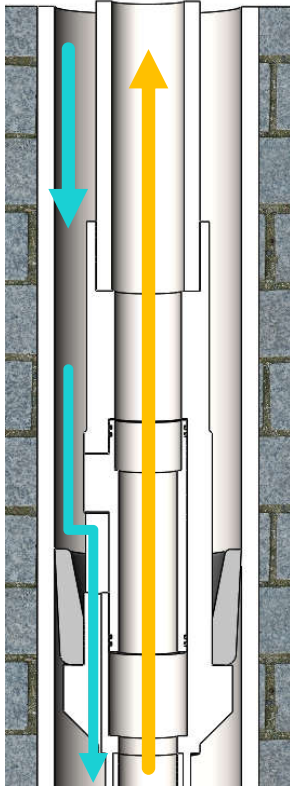
- Drilling head to drill out top hard plug in same run
- String stabilizer (optional) for centralization in hole
- Tubing
- Packer-throttle device (PDU)
- Jet pump housing with closed holes
- Tubing to surface

The well clean out job is carried out in 2 stages:

1. Reverse pumping drilling stage (until we face fluid losses)
2. Cleaning/Drilling with jet pump operating (balanced or underbalanced)

# Packer-Throttle Device (PDU) & Jet Pump Housing

## 1 stage



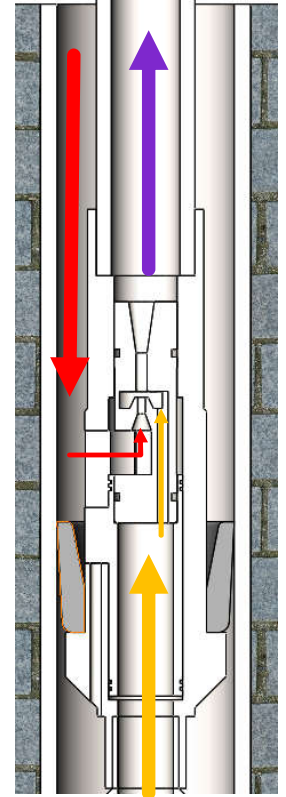
PDU is a packer-throttle device with a cup collar and throttling channels for fluid flow from above - to below-packer space during pumping at Stage 1.

The housing of the jet pump is a pipe with holes covered by a special sleeve. At stage 1, there is no tubing to annulus connection. The jet pump itself is installed inside the tubing at stage 2 and the sleeve is moved down, which opens the tubing-annulus connection holes and completely closes (or partially) the throttling channels in the packer-throttling device.

**Stage 1.** Drilling is carried out with simultaneous pumping through the annulus with the sand lifting through inside tubing space.

**Stage 2.** Sand lifting is carried out by a jet pump operations.

## 2 stage





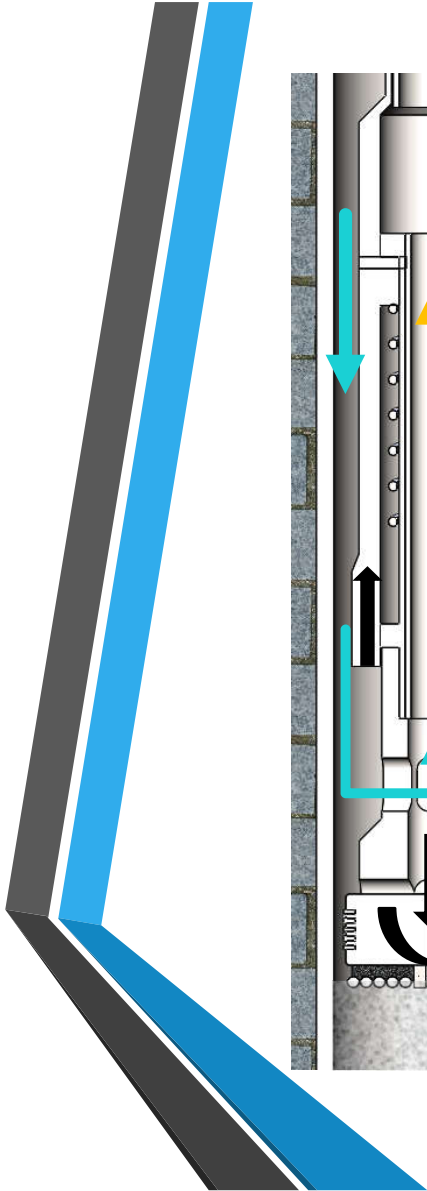
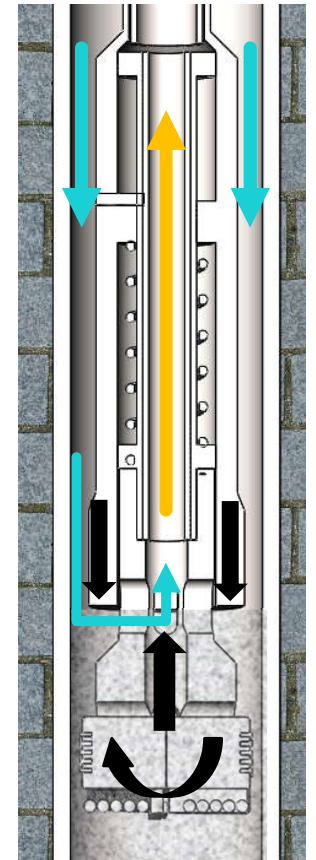
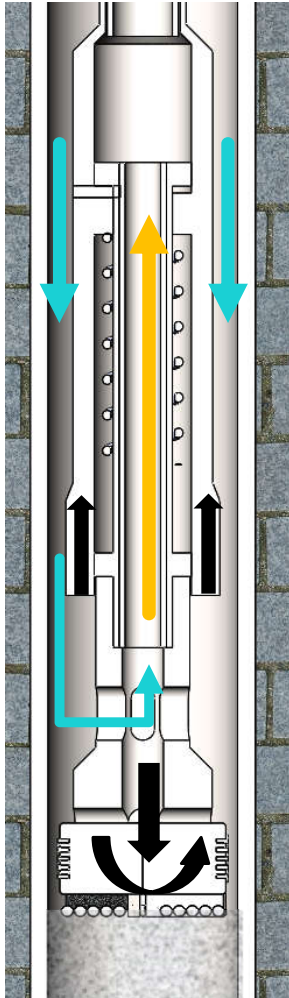
## Drilling Head

The drilling head is a rock destroying tool, with cutting rotational actions created by an axial load, while the vertical stroke of the bit is around 20-25 cm, the return to its original position is carried out by a strong spring. The spring has no contact with hole fluids hence making sure device is durable. Drilling actions are possible to do both at 1 and 2 stages.

The BHA is loaded to the bottom (the hard top of sand plug), while the bit, rotating and destroying the hard top, moves back inside the drill head.

Then BHA is picked up from bottom hence rotating drill bit moves outside the drill head and destroys sand plug top.

Thus, these actions can be repeated as many times as needed.



## Max Jet Pump Cleaning

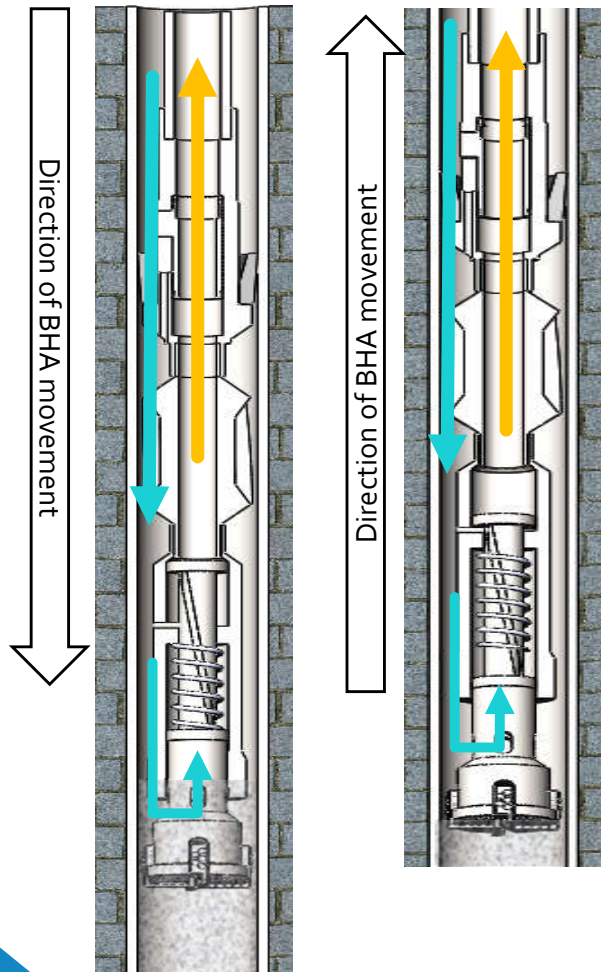
### Stage 1. Reverse pumping drilling.

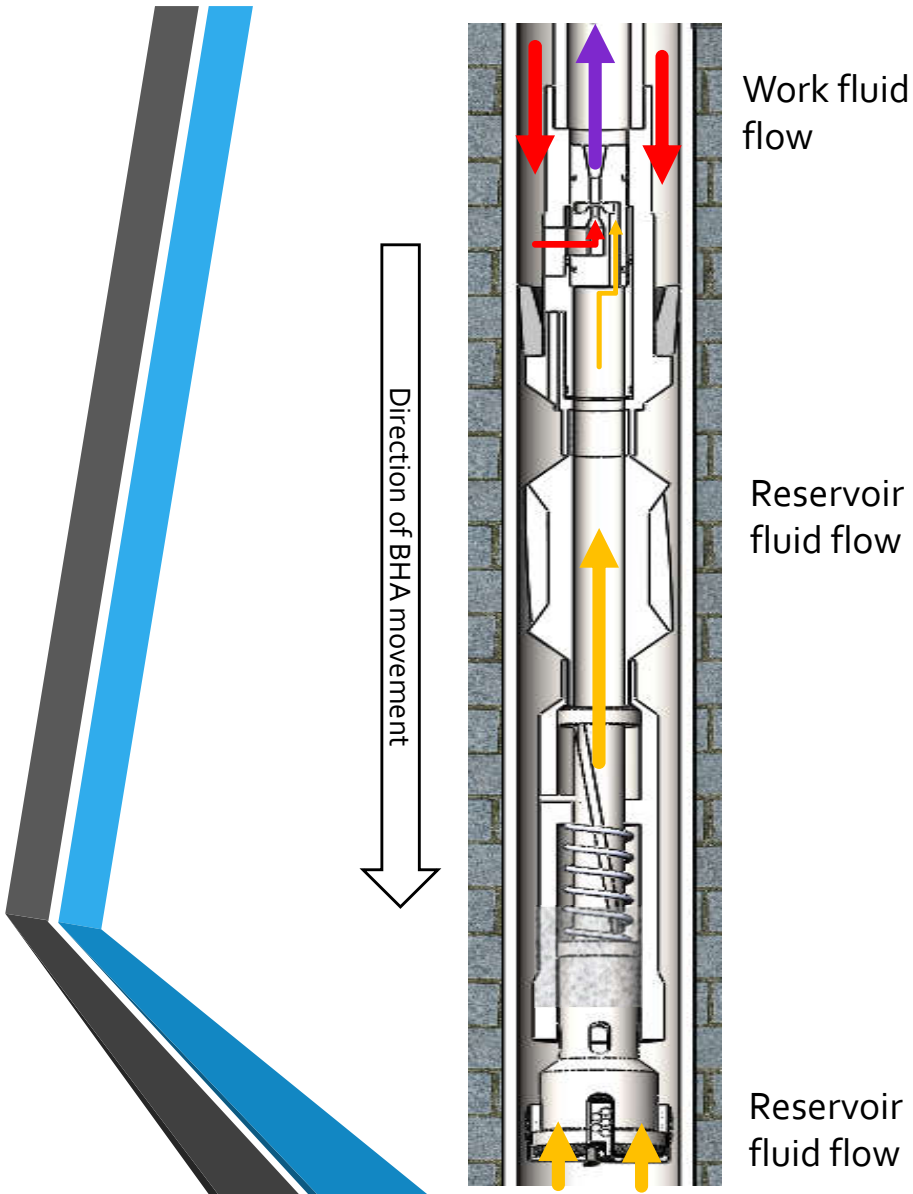
Principle of operation:

Drilling hard sand top created by the work of the drilling nozzle, making cyclic rotational-axial movements of the assembly up and down by 3-5 meters.

Lifting of the destroyed sand plug is carried out by continuous pumping through annulus with the cuttings lifting inside tubing string.

In this case, the holes (tubing-annular space) in the jet pump housing are closed with a sleeve, and the throttling channels in the packer-throttle device are completely open, which excludes the packer-throttle device packer.





# Max Jet Pump Cleaning



## Stage 2. Cleaning/Drilling with jet pump operations.

Principle of operation:

Once we face fluid loss in the formation it is necessary to switch from stage 1 to stage 2 operations.

We install the jet pump insert into the jet pump housing, while the sleeve will move down, which will block the throttling channels on the packer-throttle device and open the tubing-annular space communication to enable the jet pump to operate.

The lifting of the destroyed sand plug is carried out by the operation of the jet pump through the annular space with a gradual lowering of the assembly to required depth.

# Experience & Track Record



**> 1 500**

More than 1,500 well operations

**> 11**

More than 11 years of experience in the market



Experienced field engineers

**> 10**

More than 10 patented technologies



Design engineering group

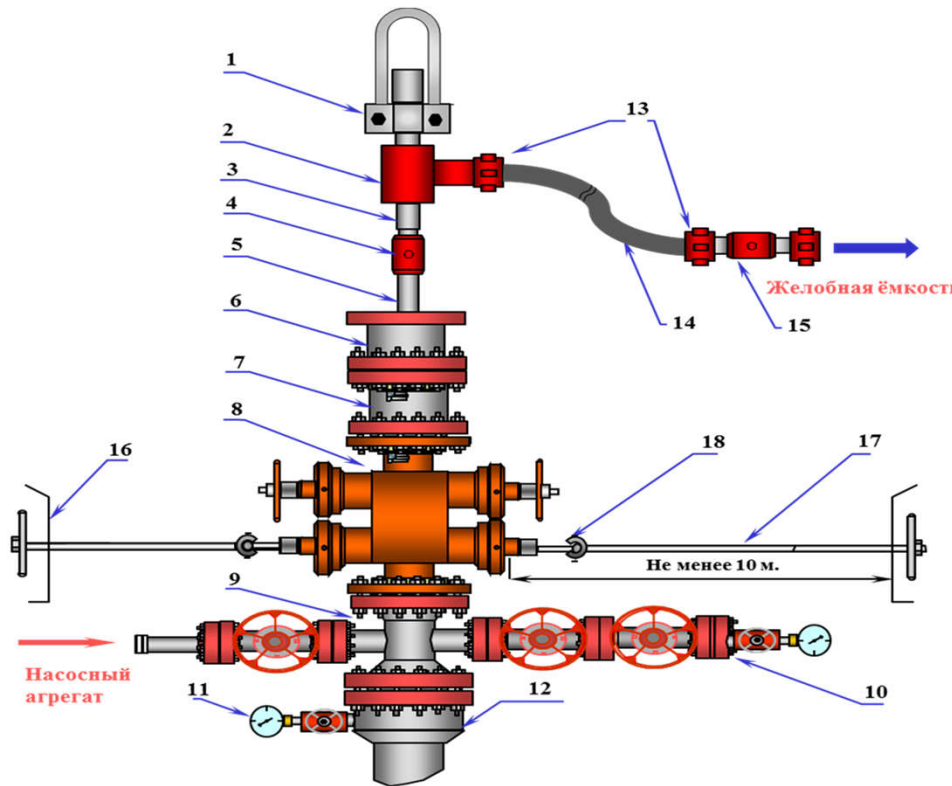
# Specific Technology Design for Oman

## Additional technologies to address Oman well conditions:

1. BHA with a jet pump, throttle device and a drilling head to ensure single run job.
2. The nozzle and tubing are run in hole with a closed choke. Drilling due to axial load and rotation, suction into the container when the throttle is opened and fluid overflow from the well into the tubing;
3. Arrangement with a downhole piston pump and a drill nozzle.
4. Drilling hard sand by the axial load and rotation, suction into the container by the piston pump;
5. Arrangement with jet pump, packer and drill nozzle. For the Oman conditions, the packer was replaced with a packer-choke device. Patent pending.
6. Track record: bottom hole cleaning after hydraulic fracturing. The maximum penetration in the liner is 350 meters with technology #2.

Nº	Well	Techn ology	Э/К	Note
1	50	1	146	Driving 2017-2065 = 48 m. Artificial bottom has been reached. Extracted 600 liters. proppant.
2	354	1	114	Driving 2672-2870 = 98 m. A sucker rod pumping pump was found in the drilling cutter during lifting. Extracted 680 liters. proppant.
3	312	2	102	Driving 3430-3462 = 32 m., Artificial bottom has been reached. Extracted 450 liters. proppant. Perforation interval 3399-3405.5 m.
4	319	1	178	Driving 2918-3042 = 124 m., Artificial face has been reached. Extracted 500 liters. proppant. Perforation interval 2862-2998.5 m.
5	306	2	178	Driving 3200-3230 = 30 m., Artificial bottom has been reached. Extracted 480 liters. proppant. Perforation interval 3200.5-3215 m
6	240	3	114	Driving 2732-2785 = 53 m. Perforation interval 2722-2774 m. Extracted 516 liters. proppant.

# Well Head Equipment



## Legend:

1. Pipe elevator.
2. Swivel VP-50 (60, 80).
3. Lifting branch pipe of the shut-off arrangement of the preventer.
4. Ball valve (the design must allow it to be lowered into the borehole, the flow diameter is not less than 40 mm).
5. Working tubing string.
6. Capture wedge rotating controlled ZKVU2-95.
7. Wellhead hermetic sealer GU 160x21, etc.
8. Small-sized double ram BOP PMT2 156x21, PPM2 156x21, PPR2 160x21 or others (pipe rams in the upper section, "blind" rams in the lower section).
9. X-mas tree cross with gate valves.
10. Flange with pressure gauge and high pressure valve.
11. Device for monitoring the pressure in the annular space of the well (manometer with a high-pressure valve).
12. Well head (OKK, OKO OOUS, etc.) or column flange.
13. Quick disconnect connection.
14. High pressure hose 50x35.
15. Ball valve KSH 60x21.
16. Metal shield with a wall thickness of at least 5 mm.
17. Remote control at least 10 m.
18. Drive KD 0001.



## Technology Features & Benefits

- The jet pump has replaceable jet pump insert. Insert change can be done by a special catcher on a wireline/slickline or with reverse circulation (in case no losses in the well)
- The jet pump housing is run in hole with special covering sleeve, the jet pump insert is dropped separately after drilling of hard sand top and when fluid losses start
- The packer-throttling device is equipped with a cup collar, which allows the assembly to be lowered down with jet pump operating (there is no anchor device)
- The packer-throttling device can be used with partially open throttling channels, it allows sand cleaning with jet pump in case no fluid inflow from the reservoir
- The drilling head drills and softens the hard sand plug by rotating the bit around its axis due to axial loading/unloading with string weight



## Values for Client

- No need for expensive CCT unit utilization, the job can be done with standard workover rig and crew
- The job is done balanced/underbalance hence not affecting reservoir production rates
- Extremely high sand cleaning speed. There is no need for rigid setting of the packer-throttling device. The packer-throttling device slides down the casing during the operation of the jet pump
- Well cleaning is done in one run operation, drilling, softening of the hard plug top and sand lifting to surface
- Cleaning actions and quality do not depend on the fluid inflow from the reservoir
- Much higher quality of sand cleaning comparing to other similar technologies



## Cup Packer Application for Selective Acid Treatment



Cup packer



Cup packer collars





Jet pump



Jet pump housing  
overlap sleeve



Drilling nozzle




Rotating drill bit





## Additional High Value Technologies

- Frac fluid unloading from the well
- Technology for best fractures clean outs after Frac job – higher production rates
- Well completions and kick offs in balanced/underbalanced mode – higher production rates
- Various types of down hole operations in balanced/underbalanced mode (with controlled and adjustable delta P in horizontal wells)
  - ✓ Well testing
  - ✓ Fluid flow profile recording
  - ✓ Formation stimulations jobs
- Formation stimulation jobs in balanced/underbalanced mode – higher production rates
- Balanced/underbalanced perforation jobs – higher production rates
- Hydromechanical stabbing perforation – higher production rates



**Thank You!**  
Q&A Session.